PATENT SPECIFICATION (11) 1 292 730

1 292 730

DRAWINGS ATTACHED

(21) Application No. 52718/70 (22) Filed 5 Nov. 1970

(31) Convention Application No. 4462 (32) Filed 11 Nov. 1969 in

(33) Norway (NO)

(45) Complete Specification published 11 Oct. 1972

(51) International Classification B01F 15/06 // 3/08

(52) Index at acceptance

B1C 10

B1X 6

(72) Inventors CHRISTIAN CAPPELEN, JR, and LARS GRIMSRUD

(54) SELF-STERILIZING LIQUID MIXER SYSTEM

(71) We, A/S NYCOTRON, a Norwegian joint-stock Company, of P.O. Box 425, 3001 Drammen, Norway, do hereby declare the invention, for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following Statement: —

The present invention relates to a self-sterilizing liquid mixer system which can be used for the preparation of a mixture of a carrier liquid and a concentrate, particularly for production of a dialysis liquid. When such systems are intermittently operated, e.g. only in the daytime, or, as in the case of a dialysis system, may be out of operation during shorter or longer periods, it is necessary to ensure that the complete system is sterile before the apparatus utilizing the liquid mixture, e.g. a dialyser, is connected to said system.

The liquid mixer system according to the invention is particularly useful in cases in which the carrier liquid has to be heated close to its boiling point and, at this temperature, has to be subjected to outgasing at atmospheric pressure, since the entire system can in a simple way be thoroughly flushed with carrier liquid at sterilization temperature, and without employing significant auxiliary equipment.

According to the present invention, we provide a self-sterilizing liquid mixer system comprising first and second inlet conduits for respectively supplying a first and a second liquid to a mixing device, series connected heating means and outgasing means in the first inlet conduit, which are adapted respectively to heat the first liquid close to its boiling point and to outgas the same through a gas outlet to the atmosphere, an outlet conduit from said mixing device, the outlet conduit being connectable to an apparatus utilizing the prepared liquid mixture, and a return conduit operative to receive used liquid mixture from said apparatus and to discharge the same through a discharge outlet; the system further comprising means for cutting off the supplies of said first and second liquid and means for interconnecting the inlet conduit of the first liquid and the discharge outlet on the one hand and interconnecting the outlet conduit of the mixing device and the return conduit on the other hand, together with means for pressure-dependently closing the gas outlet, whereby closed first liquid circulation through the system can be produced and heating of the circulating liquid can be effected by means of said heating means, and the circulating liquid heated to a selected sterilized temperature above said boiling point and determined by said pressure-dependent closing means.

The accompanying drawing discloses a schematical diagram of a system, e.g. for a dialysis liquid, according to the invention.

In the drawing 1 designates a first inlet conduit, for carrier liquid, while 2 designates the outlet for used dialysis liquid, and 3—4 are the connection terminals for the dialyser. In the inlet conduit a pressure regulator 5 and a pressure switch are disposed in the usual way. After passing these components, the carrier liquid flows through the secondary sides 7—8 of two heat exchangers, and a heating device 9 to outgasing means 10. After being subjected to outgasing in 10, the carrier liquid is conveyed through the heat exchanger primary 11 corresponding to said secondary 8, and the primary side 12 of a further heat exchange to a mixing device 13, where a concentrated dialysis liquid, supplied by way of a second inlet conduit (unreferenced) from a tank 14, is added to the carrier liquid. Before entering the mixing device 13, however, said concentrate passes the heat exchanger secondary 15 corresponding to said primary 12. Thereafter, the dialysis liquid mixture prepared in the mixing device, is conveyed through measuring means 16 and a valve 17, provided with a shunt 171 across the dialyser terminals 3—4, to the dialyser input terminal 3. After passing the dialyser, the used dialyser liquid returns to the preparation system via the terminal 4 and thereafter flows through a pressure meter 19

and a pump 18, to be ejected through said outlet 2 after passing the heat exchanger primary 20 corresponding to said secondary 7. An inlet valve 21 in the conduit 1 may be ganged with an outlet valve 22 in the second inlet conduit, i.e. that leading from the tank 14, to obtain a common control of the two valves. Between the heat exchangers 8, 11 and 12, 15, a temperature regulator 23, with associated heating means, may be disposed.

By means of heat exchange with used dialysis liquid in the heat exchanger 7, 20 and with outgased carrier liquid in the heat exchanger 8, 11, and heat supplied by heating device 9, the temperature of the carrier liquid will be raised to a value close to the boiling point, i.e., in the case of ordinary pipe water, to a temperature of 90—95°C. Thus, the outgasing will take place automatically in the outgasing means 10 under atmospheric pressure, communication with the atmosphere being provided through the aperture 101. The outgassed carrier liquid ejected from the means 10 gives off part of its heat content in the heat exchanger 8, 11, and flows to the primary side 12 of the heat exchanger 12, 15 at a temperature of 37—40°C, this temperature possibly being adjusted by means of the regulator 23. In the heat exchanger 12, 1 further heat is given off to the concentrate supplied from the tank 14. Thus, both the carrier liquid and the concentrate may have attained suitable temperatures before being mixed in the device 13, in order to supply dialysis liquid mixture of correct temperature to the dialyser via the input terminal 3. The pressure at the terminal 3 may be adjusted by means of the valve 17 with associated shunt 171.

From the dialyser output terminal 4, the used dialysis liquid is conveyed to the meter 19 and the pump 18 at a temperature of approximately 37°C, and thereafter gives off a part of its heat content in the heat exchanger 7, 20 to the fresh liquid injected through the inlet 1.

By means of the common control of the valves 21 and 22 the dialyser inlet is safeguarded against a supply of unmixed liquid.

The mixing device 13 may be provided with any suitable control means for ensuring correct mixture ratio, under the control of the measuring means 16.

The system described up to now does not fall by itself within the present invention. Certain auxiliary components are provided, however, as described below.

Between the inlet conduit, downstream of the valve 21, and the outlet conduit 2, ahead of a stop valve 24, a short-circuit conduit 25 with a valve 26 is arranged. Further, between the secondary 15 of the heat exchanger 12, 15 and the mixing device 13, a stop valve 27 is disposed, and between the dialyser terminals 3—4 there is arranged a short-circuit conduit 28 with a stop valve 29. Finally, the gas outlet 30 from the outgassing device 10 is provided with a weight-loaded safety valve 31, e.g. of the type used on ordinary domestic pressure-cookers.

When the system is to be sterilized before normal operation and subsequent to a passive period, first the shunt valve 29 is opened, and the outlet valve 24 and the concentrate valve 27 are closed; the inlet valve 21 temporarily remains open. Then the pump 18 is started, to fill the system with circulating carrier liquid before shutting the valve 21, adjusting the valve 31 and starting the heating device 9.

The preparation system is now isolated to allow a closed-path circulation of heated carrier liquid within the system by means of the pump 18. Because of the safety valve 31, however, the pressure and temperature of the liquid may rise above the atmospheric pressure and the corresponding boiling point, respectively. Thus, under the control of the weight adjustment of the safety valve 31, the system will be flushed with superheated carrier liquid to effect the sterilization of the same.

After a suitable cooling of the system, still filled with carrier liquid, it will be ready for normal operation with the addition of concentrate from the tank 14 and outgasing in the device 10 with outlet to the atmosphere.

WHAT WE CLAIM IS:—

1. Self-sterilizing liquid mixer system comprising first and second inlet conduits for respectively supplying a first and a second liquid to a mixing device, series-connected heating means and outgasing means in the first inlet conduit, which are adapted respectively to heat the first liquid close to its boiling point and to outgas the same through a gas outlet to the atmosphere, an outlet conduit from said mixing device, the outlet conduit being connectable to an apparatus utilizing the prepared liquid mixture, and a return conduit operative to receive used liquid mixture from said apparatus and to discharge the same through a discharge outlet; the system further comprising means for cutting off the supplies of said first and second liquid and means for interconnecting the inlet conduit of the first liquid and the discharge outlet on the one hand and interconnecting the outlet conduit of the mixing device and the return conduit on the other hand, together with means for pressure-dependently closing the gas outlet, whereby closed first liquid circulation through the system can be produced and heating of the circulating liquid can be effected by means of said heating means, and the circulating liquid heated to a selected sterilizing temperature above said boiling point and determined by said pressure-dependent closing means.

2. Self-sterilizing liquid mixer system as claimed in claim 1, substantially as described with reference to the accompanying drawing.

For the Applicants,
CARPMAELS & RANSFORD,
Chartered Patent Agents,
24 Southampton Buildings,
Chancery Lane,
London, WC2A 1AZ.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1972.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1292730 COMPLETE SPECIFICATION
1 SHEET This drawing is a reproduction of the Original on a reduced scale